Research Investigations 86-002, and 96-017
RDT 00-009

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# Undersealing / Diamond Grinding PCCP

**Research Development and Technology Division**

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## Description

Three independent investigations of aging Portland cement concrete pavements (PCCP), that were restored with a combination of undersealing and diamond grinding, were consolidated into one study. Undersealing fills in voids and restores support under PCCP slabs, while diamond grinding restores ride on the surface. The primary objective of this study was to measure the performance of the combination of undersealing and diamond grinding (U/D) and determine its reliability as a standard concrete pavement restoration (CPR) technique. The secondary objective was to determine the causes of early failures, if they occurred.

The combination of undersealing and diamond grinding as a CPR treatment to correct joint and crack faulting has not been used often in construction. The projects examined in this investigation are the only prime examples of U/D in Missouri, with the exception of a couple of others that were constructed too recently to acquire performance data from.

| | RI86-02 | RI96-17 | RI91-01 |
|---|---|---|---|
| Project # | 7-P-71-329 | J8I630 and J8I0631 | 1I 507-35 |
| Route | 171 | 44 | 35 |
| County | Jasper | Greene | Harrison |
| Year Original Pavement Built | 1950 | 1962 | 1974 |
| Thickness | 8" | 8" | 9" |
| Joint Spacing | 20' | 61.5' | 61.5' |
| Reinforced | no | yes | Yes |
| Load Transfer | dowel bars probable | dowel bars | dowel bars |
| Base Type | unknown | 4" Type 3 | 4" Type 3 |
| Year Rehabbed | 1985 | 1996 | 1992 |
| Length of Rehab | 7.28 miles | 11.4 miles | 2 –1000' |
| Depth of Faulting | ≤ ½" | ¾" ave. (up to 1 ½") | ¼" ave. |
| Diamond Grinding | yes | yes | Yes |
| Undersealing | yes | yes | yes (on one 1000') |
| ESALs since Rehab | 3 million | 10 million | 6 million |
| Estimated Cost per Lane-mile | $21,300 (diamond grinding only) | $22,800 | N/A |

## Findings

The different investigations of U/D projects produced an array of results.

The Route 171 project performed well, probably beyond anyone's original expectations. There is currently no justification to consider rehabilitating the pavement in the near future either.

The I-44 projects appeared to have only momentarily halted the pavements' rate of deterioration. The prevalent faulting distress reappeared within a year after they were completed. Since then, maintenance personnel have been constantly making full depth patch repairs to keep the riding surface tolerable.

The I-35 minimum (diamond grinding only) and maximum (U/D w/ edge drains) restoration test sections yielded better results than the I-44 ones. They too returned to a rehabilitation-triggering level of roughness, but at a slower speed of deterioration. Keeping in mind that a few emergency repairs at transverse crack locations were required in 1995, they provided an acceptable level of service for approximately four to five years.

## Conclusions

*General:*

1) Undersealing/diamond grinding can be an effective CPR technique under the right conditions.

*Specific:*

2) Diamond grinding an older PCCP at the joints, that is adequately supported and structurally sound, should not compromise slab performance.

3) Evidence of widespread pumping and highly plastic fine-grained subgrade soils with high in-situ water contents should eliminate a PCCP from being a candidate for U/D.

4) Retrofitting edge drains provide little, if any, additional benefit to U/D.

5) U/D should not be expected to provide more than five years of reasonable service to a PCCP with high cumulative ESALs.

6) U/D may provide ten years or more of service to a PCCP with low cumulative ESALs.

## Recommendations

1) PCC pavements that meet the following criteria, pending an appropriate evaluation, may be eligible for U/D restoration without additional rehabilitation:

- have relatively intact slabs without excessive transverse cracking
- have good load transfer
- have average faulting to a depth that will not compromise the structural integrity of the pavement slab when removed (typically £ ½")
- do not have highly plastic subgrade soils, with in-situ water contents well above optimum, that are prone to widespread pumping

2) Design life assumptions for PCC pavements that receive U/D restoration should fall within the following ranges:

- no more than five years for pavements defined as heavy duty by ESAL loadings
- five to ten years for pavements defined as light or medium duty by ESAL loadings